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References not used in the text are automatically
deleted from this section of the project
specification when you choose to reconcile
references in the publish print process.

The publications listed below form a part of this specification to the
extent referenced. The publications are referred to within the text by the
basic designation only.

ASME INTERNATIONAL (ASME)

ASME B36.10M (2004) Standard for Welded and Seamless
Wrought Steel Pipe

ASTM INTERNATIONAL (ASTM)

ASTM A 106/A 106M (2008) Standard Specification for Seamless
Carbon Steel Pipe for High-Temperature
Service

ASTM A 53/A 53M (2007) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM B 88 (2003) Standard Specification for Seamless
Copper Water Tube

ASTM B 88M (2005) Standard Specification for Seamless
Copper Water Tube (Metric)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-58 (2002) Standard for Pipe Hangers and
Supports - Materials, Design and
Manufacture

MSS SP-69 (2003; R 2004) Standard for Pipe Hangers
and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 12 (2007) Standard on Carbon Dioxide
Extinguishing Systems

NFPA 72 (2006) National Fire Alarm Code

UNDERWRITERS LABORATORIES (UL)

UL 536 (1997; Rev thru Jun 2003) Standard for
Flexible Metallic Hose

1.2 SYSTEM DESCRIPTION

NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION,
AND EXHAUST SYSTEMS is not included in the project
specification, insert applicable requirements

therefrom and delete the following paragraph.

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, AND EXHAUST SYSTEMS applies to work specified in this section.

1.2.1 Design Requirements

NOTE: Modify the following paragraph to suit project requirements.

Give full consideration to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment. System must be free from operating and maintenance difficulties.

Devices and equipment must be a make and type listed by the Underwriters Laboratories, Inc. (UL), or Factory Mutual (FM) approved. In the UL and FM publications, consider the advisory provisions to be mandatory. Interpret reference in publications to the "authority having jurisdiction" to mean the Kennedy Space Center Fire Protection Engineer.

NOTE: Select system type.

System must be an approved high-pressure carbon dioxide [hand] [hose] [reel] total flooding type system conforming to NFPA 12.

Electrical work associated with the system must meet the requirements of the appropriate sections of Division 16, "Electrical," pertaining to fire detection.

Components used in the installation must be new, unused and not be greater than one (1) year old from the date of manufacture.

NOTE: Use Section 23 05 48.00 40 VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT as a guide for vibration isolation.

1.2.2 Performance Requirements

NOTE: Discharge of carbon dioxide into an enclosed space creates a dangerous oxygen deficiency for personnel. Dilution of oxygen in the air by the carbon dioxide concentrations necessary to extinguish the fire creates atmosphere that does not sustain life.

Carbon dioxide must be supplied from 25-, 40-, 50-kilogram 50-, 75-, or 100-pound high-pressure cylinders and must be stored in rechargeable containers designed to hold pressurized carbon dioxide in liquid form at atmospheric temperatures corresponding to a normal pressure of 5860 kilopascal at 21 degrees C 850 pounds per square inch (psi) at 70 degrees F.

High-pressure cylinders must be constructed, tested, and marked in accordance with U.S. Department of Transportation specifications for seamless steel cylinders.

Provide each cylinder with a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure. Devices must be Interstate Commerce Commission approved frangible safety disks.

Support carbon dioxide cylinders by suitable racks attached to walls and floor. Fit cylinder framing with a weighing bar bracket, weight bar, and direct-reading scale to weigh cylinders in place without deactivating the system.

Arrange system for fully automatic, manually operated, and remote-pushbutton electric control operation. Operating controls must be the enclosed release type to prevent accidental operation.

1.3 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Keep submittals to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, use a code of up to three characters within the submittal tags following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government.] Submit the following in accordance with Section 01 33 00

SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit connection diagrams indicating the relations and connections of the following items. Drawings must indicate the general physical layout of all controls, and internal tubing and wiring details.

Carbon Dioxide Cylinders
Piping Materials
Carbon Dioxide Control Panel

Submit [Installation Drawings](#) and [As-Built Drawings](#) in accordance with paragraph entitled, "General," of this section.

SD-03 Product Data

Submit [Equipment Foundation Data](#) in accordance with paragraph entitled, "General," of this section.

Submit Manufacturers Catalog Data for approval for the following items:

Piping Materials
High-Pressure Cylinders
Escutcheons
Supporting Elements
Flexible Metallic Hoses

SD-05 Design Data

Submit [Design Analysis and Calculations](#) in accordance with paragraph entitled, "General," of this section.

SD-06 Test Reports

Submit test reports for the following tests in accordance with the paragraph entitled, "Field Testing," of this section.

Pressure Tests
System Tests

Submit [Request for Inspection and Test](#) in accordance with paragraph entitled, "Preliminary Tests," of this section.

SD-07 Certificates

Submit [Listing of Product Installation](#) for carbon dioxide fire-protection systems in accordance with paragraph entitled, "Installation," of this section.

Submit certificates for the following items showing conformance with the referenced standards contained in this section.

Qualifications of Installer

SD-08 Manufacturer's Instructions

Submit [Operating Instructions](#) in accordance with paragraph entitled, "Operating Instructions," of this section.

[SD-10 Operation and Maintenance Data](#)

Submit [Operation and Maintenance Manuals](#) in accordance with paragraph entitled, "Operating Instructions," of this section.

1.4 GENERAL

Submit [Equipment Foundation Data](#) for carbon dioxide fire-protection systems consisting of the following information:

Equipment weight and operating loads.

Horizontal and vertical loads.

Size, location, and projection of anchor bolts.

Horizontal and vertical clearances for installation, operation and maintenance.

Plan dimensions of foundations and relative elevations.

Installation requirements such as noise abatement, vibration isolation, and utility service.

Submit [Installation Drawings](#) for carbon dioxide fire-protection systems in accordance with the requirements of [NFPA 12](#). Drawings must include details of equipment layout and design.

Submit [As-built drawings](#) for approval 14 days prior to the acceptance testing phase of the project, as described in the paragraph entitled, "Field Testing" of this specification section. Provide (2) sets of magnetic media and hard copies of all drawings with the submittal. As-built drawings must document final system configuration including deviations from and amendments to the drawings, and field installation changes, concealed and visible.

Provide .DWG or .DGN format computer generated floor plan layouts indicating all system components.

Submit [Design Analysis and Calculations](#) for carbon dioxide fire-protection systems including spray areas, hazard by class, and pressure calculations.

1.5 QUALITY ASSURANCE

1.5.1 [Qualifications of Installer](#)

Qualifications of System Technician: Installation drawings, shop drawings and as-built drawings must be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies [_____] as an engineering technician with minimum Level-III certification in Special Hazard System program. Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

PART 2 PRODUCTS

2.1 EQUIPMENT

Use only UL-listed or FM-approved equipment and devices in the systems.

System must be designed and constructed to include a fixed supply of carbon dioxide cylinders connected to properly sized, fixed piping with fittings and nozzles to direct this agent into an enclosure surrounding the hazard.

2.2 COMPONENTS

2.2.1 Piping

NOTE: Revise the following paragraph to suit
project requirements.

Manifolds and distribution piping materials must be galvanized, ferrous piping, Schedule [40] [80], conforming to [ASTM A 53/A 53M] [ASTM A 106/A 106M] [ASME B36.10M]. Nonferrous drawn seamless copper tubing must conform to ASTM B 88M ASTM B 88. Flexible metallic hoses must conform to UL 536.

Reduce pipe sizes in the fitting. Flush bushings must not be used. Brazed joints, when used, must be fused with an alloy with a melting point above 538 degrees C 1,000 degrees F.

Pipe and fittings must have a minimum bursting pressure of 34.5 Megapascal 5,000 psi. For DN 15 and DN 20 1/2-inch and 3/4-inch iron pipe size (ips), the pipe must be Schedule 40. For DN 25 1 inch or greater, the pipe must be Schedule 80. Use standard malleable iron banded fittings or ductile iron fittings up through DN 20 3/4-inch ips. Use extra heavy malleable iron or ductile iron fittings through DN 50 2-inch ips. Use forged steel fittings in all sizes over DN 50 2 inches.

A dirt trap (leg) consisting of a tee with a capped nipple, at least 50 millimeter 2 inches long, must be installed at the end of each pipe run.

Use baffle-type nozzles for distribution in normal total flooding systems. Install strainers ahead of small-orifice nozzles to prevent clogging.

Permanently mark discharge nozzles to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices.

Conceal piping to the maximum extent possible. Piping must be inspected, tested, and approved before being concealed.

Joint compound for pipe threads must be pipe cement and oil or graphite and oil.

Pipe hangers and supports must be MSS SP-58 and MSS SP-69, adjustable type, zinc-coated. Spacing to be as follows:

<u>Nominal Pipe Size (DN)</u>	<u>Maximum Spacing (millimeter)</u>
15 and under	2130
32	2440
40	2740
50	3050
65	3350
80	3660
90	3960
100	4270
125	4570
150	4880

<u>Nominal Pipe Size (inches)</u>	<u>Maximum Spacing (feet)</u>
1 and under	7
1.25	8
1.5	9
2	10
2.5	11
3	12
3.5	13
4	14
5	15
6	16

2.2.2 Pipe Sleeves

Provide pipe sleeves where piping passes through masonry or concrete walls, floors, roofs, and partitions. Sleeves in outside walls below and above grade, in floor, or in roof slabs, must be Schedule 40 zinc-coated steel pipe. Sleeves in partitions must be zinc-coated sheet steel having a nominal weight of not less than 4.4 kilogram per square meter 0.90 pound per square foot. Space between piping and the sleeve must be not less than 6 millimeter 0.25 inch. Place sleeves securely in proper position and location during construction. Sleeves must be of sufficient length to pass through the entire thickness of walls, partitions, or slabs. Sleeves must extend 50 millimeter 2 inches above finished floor slabs. Space between

the pipe and sleeve must be packed with insulation and both ends of the sleeve must be calked with plastic waterproof cement.

2.2.3 Escutcheons

Provide approved-type escutcheons for piping passing through floors, walls, and ceilings. Escutcheons must be one-piece or split-type and, where pipe passes through finished ceilings, must be chrome-plated. Other escutcheons must be of steel or cast iron, with aluminum paint finish. Securely fasten escutcheons in place with setscrews or other positive means.

PART 3 EXECUTION

3.1 INSTALLATION

Install materials and equipment in accordance with NFPA 12.

Provide each system complete and ready for operation.

Provide each system with an approved pressure-relief device designed to operate between 16.5 and 20.7 Megapascal 2,400 and 3,000 psi and located between the storage cylinder manifolds and any normally close valve.

Submit Listing of Product Installation for carbon dioxide fire-protection systems showing at least 5 installed units, similar to those proposed, that have been in successful service for a minimum period of 5 years. List must include purchaser, address of installation, service organization, and date of installation.

3.1.1 System Control

3.1.1.1 Controls

NOTE: Select control type.

Actuating control system must be [manual] [combination] [electric]
[pneumatic] [mechanical pull cable].

3.1.1.2 Control Stations for Underfloor Flooding Systems

Actuation stations for underfloor flooding systems must be provided at the principal exits from the protected area. Provide a separate actuation for the main supply and reserve supply of carbon dioxide at each location.

3.1.1.3 Pressure-Operated Fire Alarm Switch

Provide a pressure-operated switch to actuate the building interior fire alarm system upon the discharge of gas into the carbon dioxide system piping for each separate system.

3.1.1.4 Pressure-Operated Equipment Switch

Provide a pressure-operated switch to automatically shut down the air handling equipment serving the protected space upon the discharge of gas into the carbon dioxide system piping for each separate system.

3.1.1.5 Suppression System Safing/Disconnect Switch

Both conductors of the solenoid/actuator/electric release head circuitry must be Class B wired, connected in series to a Best Lock Switch No. 1W7D2 (DPST), such that opening the switch interrupts both conductors. Install switch in a weatherproof enclosure outside the primary entrance door to the facility. A sign must explicitly indicate its purpose as "CARBON DIOXIDE SYSTEM SAFING SWITCH".

3.1.1.6 Control Panel

Provide Carbon dioxide control panel for complete electrical supervision of actuating circuitry in accordance with NFPA 72. Install a modular type panel in a flush- or surface-mounted steel cabinet with hinged door and cylinder lock. Control panel must be a neat, compact, factory-wired assembly containing the parts and equipment required to provide specified operating and supervisory functions of the system. A ground fault condition that prevents the required operation of the system or a single break in any of the actuating circuits must result in the activation of a system trouble signal. Loss of ac power must also result in the operation of the system trouble signal.

3.1.2 System Power

3.1.2.1 Primary Supply

System power must be 120-volt, 60-hertz service, transformed through a two-winding isolation-type transformer and rectified to 24 volts dc for operating trouble signal and actuating circuits. Provide a secondary dc power supply for operation of the system if the ac power fails. Transfer from normal to emergency power or restoration from emergency to normal power must be fully automatic. Locate trouble lights on the door of the cabinet. Cabinet must be finished on the inside and outside in red enamel with prominent rigid plastic or metal identification plates attached.

3.1.2.2 Secondary Supply

Secondary power supply must include [nickel cadmium] [lead calcium] [sealed lead acid] batteries and charger. Dry cell batteries must not be used. Batteries must be housed in a well-constructed steel cabinet with cylinder lock.

3.1.2.3 Storage Batteries

Batteries must be of the proper ampere-hour capacity to operate the system under supervisory conditions for 24 hours. Provide calculations substantiating the battery capacity.

3.1.2.4 Battery Charger

Battery charger must provide completely automatic high/low charging rate capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide an ammeter showing rate of charge and a voltmeter to indicate state of battery charge. A red pilot light must indicate when batteries are manually placed on a high rate of charge, if a high-rate switch is provided.

3.1.3 Electrical Work

Electrical work is specified in Section 21 09 00.00 98 FIRE-ALARM SYSTEMS.

3.1.4 Operating Instructions

Provide operating instructions at each remote control station. Instructions must clearly indicate necessary steps for the operation of the system.

Submit [6] [] copies of the [Operation and Maintenance Manuals](#) 30 days prior to testing the carbon dioxide fire-protection systems. Update and resubmit data for final approval no later than 30 days prior to contract completion.

Submit [Operating Instructions](#) for carbon dioxide fire-protection systems consisting of raised or embossed white letters on red rigid plastic or enameled steel background, adequately sized to permit them to be easily read.

3.1.5 Field Painting

Painting of the system must be in accordance with painting sections included in this specification.

3.2 FIELD QUALITY CONTROL

Testing to determine conformance with the requirements must be conducted in the presence of the Contracting Officer.

3.2.1 Preliminary Tests

Perform and record [Pressure tests](#) and [system tests](#).

Each piping system must be tested pneumatically at [1034 kilopascal 150 pounds per square inch gage](#) and must show no leakage or reduction in gage pressure after 2 hours. Upon completion and before final acceptance of the work, test each piping system by discharging a minimum of one [34 kilogram 75-pound](#) high-pressure cylinders of carbon dioxide to demonstrate the reliability and proper functioning of pressure-operated switches and the discharge of carbon dioxide gas from each system discharge nozzle. Individually test remote control stations, and all other components, [supporting elements](#) and accessories to demonstrate proper functioning. At the completion of tests and corrections, submit a signed and dated certificate to the Contracting Officer attesting to the satisfactory completion of all testing and that the system is in operating condition.

Submit a written [Request for Inspection and Test](#) to the Contracting Officer for carbon dioxide fire-protection systems.

3.2.2 Formal Tests

At a time to which the Government has agreed, the Contracting Officer and Government Fire Protection Engineer must witness formal tests and approve systems before they are accepted. An experienced technician regularly employed by the system installer must be present during the inspection. At this inspection repeat any or all of the required tests as directed by the Contracting Officer. Carbon dioxide, instruments, personnel, appliances, and equipment for testing must be furnished by the Contractor at his

expense.

3.2.3 Manufacturer's Representative

Provide an experienced manufacturer's field engineer to supervise installation and testing of the system.

-- End of Section --